Design for Manufacture and Assembly (DfMA) and Modular Prefabrication – Methods for Workforce Training

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John Russell

- Member of the United Association Plumbers & Pipefitters LU 5 in Washington, D.C.
- Eighteen years of experience in the supervision of VDC coordination departments
- Instructor since 1989 teaching Applied Drawing, BIM, VDC, AutoCAD, Revit, Fabrication, Navisworks, and BIM 360
- Instructor at the UA Instructor Training Program since 1991
- Member of the United Association's national VDC group of instructors

Diana Lee

- Member of the United Association of Pipefitters & Service Techs in Wisconsin
- Over a decade of experience in construction, from hydraulic tank manufacturing, welding/fitting in fabrication shops to VDC manager for multi-trade contractors
- Currently works as a Revit instructor and virtual design administrator
- Instructor at the UA Instructor Training Program since 2019
- Member of the United Association's national VDC group of instructors
Session Overview

ABOUT THE UA

• What is the United Association?
  • Pipe trade Journeyworkers & Apprentices
  • UA training

DfMA & MECHANICAL INSTALLATION

• Applying DfMA to prefabrication processes
  • Generative Design & Modular Assembly
  • Automation

WHAT IS DfMA?

• What does DfMA actually represent?
  • How do we apply it?
  • What does it look like in the field?

WORKFORCE TRAINING

• The UA training approach
  • The Fabrication Training Container
  • Fabricated Training Modules
About The UA

The United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry of the United States & Canada (UA), affiliated with the national building trades, represents approximately 356,000 plumbers, pipefitters, sprinkler fitters, service technicians and welders in locals across North America. We also honor a federation agreement with both the Australian Plumbing Trades Employees Union (PTEU) and Irish Technical, Engineering and Electrical Union (TEEU).
The United Association

The UA has been training qualified pipe professionals longer than anyone else in the industry. We boast these premier training programs available today:

- **Instructor Training Program (ITP):**
  - The UA’s well-respected and highly effective college accredited program of instructor education.

- **Certifications:**
  - Our certifications guarantee our contractors and users that the craftsmen they hire have been tested and meet the highest standards.

- **College Degrees:**
  - All UA members are eligible to earn a wide variety of college degrees as part of their training.

- **Construction Supervision:**
  - UA members who wish to move into a construction management position can become certified supervisors.

- **Accelerated Welder Training and VIP Program:**
  - This program is an 18-week intensive curriculum that prepares members to be certified in specific welding procedures.
United Association BIM/VDC Training Courses

- Revit
- AutoCAD Fabrication MEP
- DfMA and Modular Fabrication
- BIM 360
- Laser Scanning
- Virtual & Augmented Reality
- Total Robotic Station
- Drone Applications
The UA VDC Group of professionals promoting instruction in BIM, VDC and advanced jobsite technologies.

*UA Training Specialist
DfMA: Design for Manufacture and Assembly
What is DfMA?

DfMA is the combination of two methodologies:

Design for Manufacture, which means the design for ease of manufacture
of the parts that will form a product, and

Design for Assembly, which means the design of the product for ease of assembly.

Wikipedia

Design for Manufacture and Assembly (DfMA) is a design approach that focuses on ease
of manufacture and efficiency of assembly.

By simplifying the design of a product it is possible; to manufacture and assemble it more efficiently, in
the minimum time and at a lower cost.

Designing Buildings Wiki (UK)
DfMA for Mechanical Installation
DfMA for Mechanical Contractors

Designing for the manufacture of fabricated piping/equipment modules and assemblies will allow efficiency of manufacture and assembly of mechanical piping and plumbing systems within buildings.

- Prefabrication of piping and equipment are our manufacturing processes
- The installation of prefabricated piping assemblies and modules within buildings are our assembly processes

Simplifying the design of piping and equipment modules

- Allows faster and more efficient fabrication
- Allows faster and more efficient field installation of the fabricated modules
Prefabrrication
DfMA concepts are applied to mechanical piping and equipment installation workflows through prefabrication processes.
Application of DfMA to Prefabrication Processes

PARAMETRIC & GENERATIVE DESIGN
Design of spool assemblies and modular assemblies must reflect efficiency and economy in fabrication time and use of materials.

MODULARIZATION
Fabrication of modular assemblies consisting of prefabricated spool assemblies allows ease of field installation.

AUTOMATION (ROBOTICS)
Automating tasks for fabrication of spool assemblies and modular assemblies increases productivity and accuracy.
Generative Design, Modular Assembly and Automation
Generative Design

Using Generative Design for Revit and Dynamo

Traditional, Parametric and Generative Design
• From pen and paper to cloud-based collaboration

Generating and Optimizing
• Where do building trades go from here?
Design Automation

• Revit
  o Contains automated tasks "out of the box"

• Dynamo
  o Complimentary to Revit
  o Framework for more complex automated tasks

Programming repetitive tasks in Revit makes future time and effort more efficient in the long run
Modular Assembly

Modular fabrication allows for ease of installation of mechanical systems in the field

- Piping and equipment modules are built utilizing pre-fabricated component assemblies

Generative Design for Revit helps to determine arrangements of module components

- Alternate locations for assemblies within the module are reviewed and considered
Cloud-based fabrication and robotic cutting

- Cut lists directly downloaded from models
- Accuracy of measurements reduces human error
- Minimizes waste
STRATUS

Cloud-based program with direct model download of cut lists to TigerStop and other automated tools

PypeServer

Cloud-based automated program that connects to various machines used in the fabrication process
UA Training for DfMA – Training for the Future
Training for the Future

- Generative Design for buildings will affect the way piping is designed and installed
- Modular assembly is already being used in the Mechanical industry - future application will increase
- The use of automation and robotics will greatly affect the pace of the construction industry
How are we Training for DfMA in Mechanical Installations?

PARAMETRIC & GENERATIVE DESIGN
- Training in 3D modeling utilization and production
- Revit, Dynamo and Generative Design for Revit classes
- Navisworks Manage clash detection
- BIM 360 training

MODULAR CONSTRUCTION
- Multi-trade module design
- Multi-trade module manufacturing and coordination
- Multi-trade module installation methods

AUTOMATION
- Training in use of automated fabrication tools (TigerStop, PypeServer, etc)
- Training for use of jobsite robotic tools
The UA Fire Protection Training Module

One of four training modules built for Fire Protection Training

- Includes fire pumps, various sprinkler systems and special hazard systems
UA Training Modules

- Process Piping
- Centrifugal Pump Skid
- Water Heater and Lavatory
- Refrigeration Module
- Metering Devices
- ...many options for our industry

Interchangeable combinations for tradeshows

- Freight container will be at AU 2021!
MOBILE Training Unit

- Interchangeable prefabricated training module for piping and equipment assemblies
- Assemblies are stored in a freight container for transport to UA regional training centers and local union training facilities
  - Instruction in modular construction, DfMA, generative design and automation workflows
Connect with the United Association

ua.org

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